KENTUCKY GEOLOGICAL SURVEY
UNIVERSITY OF KENTUCKY
LEXINGTON, KENTUCKY

Director and State Geologist
DONALD C. HANEY

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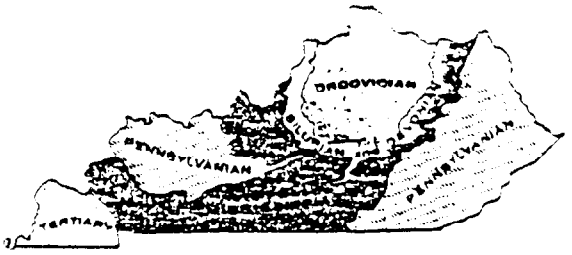

KENTUCKY RESEARCH GROUP
606/257-2696

July 12, 1979

Mrs. Nancy P. Dutro
American Geological Institute
5205 Leesburg Pike
Falls Church, Va. 22041

Re: IX-ICC Manuscript No. 112, Jaffrey S. Zafar and Edward Norman Wilson, Nature and Position of Devonian-Mississippian Boundary in Eastern Kentucky and Contiguous Areas.

Dear Mrs. Dutro:

Enclosed are the text and graphics in duplicate of the above mentioned manuscript. This manuscript has been reviewed by the editor of the Kentucky Geological Survey.

I thank you once again for extending the date of submission.

Yours truly,

Jaffrey S. Zafar

JSZ/ah

Enclosure

cc: Don C. Haney
Edward N. Wilson

UGR FILE # 240

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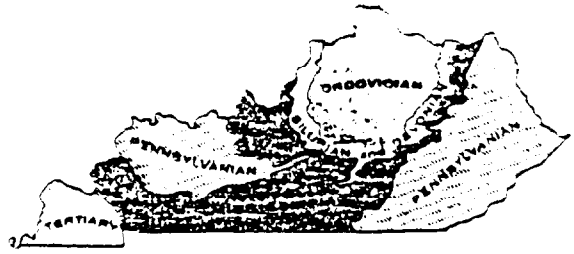

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UGR FILE # 240

NATURE AND POSITION OF THE DEVONIAN-MISSISSIPPIAN BOUNDARY IN EASTERN KENTUCKY AND CONTIGUOUS AREAS

Jaffrey S. Zafar

and

Edward Norman Wilson
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Lexington, Kentucky 40506

ABSTRACT

Uncertainties in positioning the Devonian-Mississippian boundary in northeastern Kentucky, eastern Ohio, and western Pennsylvania may be clarified by subsurface stratigraphic data, particularly sample studies. Subsurface lithostratigraphy indicates that the Berea Sandstone lies on an unconformity at the base of the Mississippian System in northeastern Ohio. It is in facies relationship with the Murrysville Sandstone of western Pennsylvania. The "Bedford Shale" postulated to lie between them (deWitt, 1970) is not found in the subsurface; but medium-gray silty shale is commonly found interbedded in both. The Murrysville is the base of the Mississippian in its area; its typical lithology, coarse-grained sandstone, is like that of the Cloyd Conglomerate at the base of the Mississippian in Scott County, southwestern Virginia.

Along the northeast border of Kentucky, the base of the Mississippian System is taken to be at the base of the Berea Sandstone. The Berea is very fine-grained and silty in the notthwest, becomes coarser to the southeast where it is an important gas-bearing zone, and correlates with the relatively

thin Cloyd Conglomerate found southeast of the projection of the Pine Mountain structure. The thickness of the Berea is variable; and it appears to rest unconformably on the Bedford Shale, Cleveland Shale Member (black and radioactive) of the Ohio Shale, or a light-colored nonradioactive siltstone and silty shale referred to the Brallier Formation in Virginia. All these substrates are considered to be Devonian in age.

From Wayne County in east-central Ohio south to Lawrence County (adjacent to Kentucky) the Berea Sandstone lies on a thin body of "Red Bedford," a red silty shale of irregular thickness resembling the Catskill Shale found under the Berea farther east. In the area between occurrences of "Red Bedford" and Catskill Shale, the Berea is underlain by reddish- and grayish-brown and brownish- or medium-gray shales thought to be part of the Chagrin Shale, which is older than the Catskill. The "Red Bedford" apparently equals the Catskill Shale; and the area of Chagrin Shale subcrop may be the axis of a pre-Mississippian anticline or hinge-line.

Red coloration is not found in the Bedford Shale near and southeast of the Mavity monocline on the northwest boundary of the Rome Trough. The absence of red coloration may be the result of deposition of originally red material in a deep reducing environment in the trough.

In the area studied, the Devonian-Mississippian boundary is everywhere at the unconformity under the Berea Sandstone and its equivalents. Apparently the unconformity becomes obscure westward where the Berea is absent.

NATURE AND POSITION OF THE DEVONIAN-MISSISSIPPIAN BOUNDARY IN EASTERN KENTUCKY AND CONTIGUOUS AREAS

INTRODUCTION

There is much inconsistency in the positioning of the Devonian-Mississippian boundary in the western Appalachian Basin. In western Pennsylvanian this boundary is placed at the base of Murrysville Sandstone; and in northeastern Ohio near the base of gray Bedford Shale. In central Ohio, it has been placed at the base of "Red Bedford." In the Kentucky subsurface, where the Berea Sandstone and Bedford Shale are indistinguishable on geophysical logs, it has been placed at the base of gray Bedford Shale; and in Virginia it is at the base of the Cloyd Conglomerate or somewhere in the Big Stone Gap Shale.

In order to assign a definite and acceptable Devonian-Mississippian boundary, we feel it is important to take an overall view of the western Appalachian Basin and understand the distribution and correlations of various Devonian and Mississippian units near it.

This is principally a subsurface study based on some 200 of the 1,500 sample studies in the Appalachian Basin made by the speaker over a nine-year period.

INDEX MAP

As shown on the Figure 1, we have constructed three stratigraphic cross sections. The East-West Ohio-Pennsylvania cross section extends from Somerset County, central Pennsylvania, through Brooke County, West Virginia, to Medina County in north-central Ohio. It serves to illustrate the relations

of the "Red Bedford" in Ohio with the Catskill of Pennsylvania.

The North-South cross section extends from Cuyahoga County, northern Ohio, to Holmes County, where it angles east then west, and then continues from Muskingum County, Ohio, to Boyd County, Kentucky, where it crosses the Mavity Monocline, the position of the northwesternmost fault bounding the Rome Trough. It thus extends from craton to trough, generally following the occurrence of the "Red Bedford."

The Southern Tie Section extends southeastward from Devonian Shale outcrop in Ross County, Ohio, crossing the Mavity monocline in Boyd County, Kentucky, the Warfield fault in Martin County, Kentucky, and the projected position of the Pine Mountain fault in Buchanan County, Virginia. From Buchanan County, Virginia, it angles south in one 37-mile step to Scott County, Virginia, which is deep into the Valley and Ridge Province, near the southwestern limit of the Berea Sandstone's equivalent.

The "Red Bedford" occurs in a long oval area, its west edge approximately on the Waverly Arch. It is separated from the area of Catskill occurrence, but their lithologies are similar.

WEST-EAST OHIO-PENNSYLVANIA CROSS SECTION

This section (Figure 2) extends from Somerset County, Pennsylvania, westward to Medina County, Ohio, but we have extended our study along this line to Seneca County, Ohio, on the Waverly Arch.

SUNBURY SHALE

The section is "hung" at the base of the black, marine, carbonaceous, bituminous, and highly radioactive Sunbury Shale. By its Siphonodella fauna (deWitt, 1970, p. 62), it is Mississippian (Kinderhook) in age. The top of Sunbury may be a little higher than shown in Well No. 3 (Wayne County), for black shale occurs as stringers further up the hole. The Sunbury Shale is absent east of Jefferson County, Ohio, but a Sunbury-type black shale occurs again in Well No. 13 (Somerset County, Pennsylvania.) We suggest that its absence in between, in West Virginia and western Pennsylvania, is due to post-Sunbury erosion, since black shales are generally quite continuous. Could the "black stringers" in Well No. 3 be debris of that erosion?

MURRYSVILLE AND BEREA SANDSTONES

On the east side of Figure 2, Murrysville Sandstone underlies the Sunbury. In the subsurface it is typically a white, fine- to very coarse-grained, poorly sorted, friable, pebbly sandstone. Glauconite, present in some well cuttings, it is not common. The Murrysville Sandstone thickens and coarsens to the east. Wallace deWitt, Jr. (1970) cites the occurrence of Mississippian Adiantites flora in the Murrysville to establish its Mississippian age. This point supports the thesis that the Devonian-Mississippian boundary here is at the base of the Murrysville.

On the west side of the section the Berea Sandstone, in the subsurface, is typically a white to light gray, relatively very fine- to fine-grained, fairly well sorted, friable to

hard sandstone, glauconitic in some wells. It becomes finer and siltier toward the west.

On the east side of the section, in Wells No. 13 (Somerset County, Pa.) No. 12 (Fayette County, Pa.), and No. 9 (Washington County, Pa.), typical Murrysville coarse-grained lithology is overlain by fine-grained sandstone like typical Berea. Similarly, the typical Berea Sandstone is underlain by coarse sandstone like the Murrysville in the west in Well No. 5 (Stark County, Ohio). These occurrences of relatively fine-grained "Berea" and relatively coarse-grained "Murrysville" together suggests that the lithologic distinctions made between the two on the basis of typical grain size is meaningless and that they are in fact the same unit. We suggest that Murrysville and Berea are two names for the same continuous unit and that the relative fineness of grains of the Berea is due to its being a greater distance from the source of the sediment, thought to be to the east.

These sandstones seem characteristic of the initial deposit of a transgressing sea and may reflect either a deltaic or restricted marine environment. The variation in thickness of Berea and Murrysville suggests an irregular initial surface of deposition such as at an unconformity. Wallace deWitt (1970) reports that a discrete body of Bedford Shale separates the Berea and Murrysville Sandstones vertically in northeastern Ohio and northwestern Pennsylvania north of this cross section. On this section (Figure 2) there is no such body of shale: there are intercalated medium-gray shales locally in both the Berea and Murrysville, which we believe are different from the Bedford Shale underlying the Berea in Kentucky which

appears to be entirely Devonian in age.

CONEWANGO GROUP

In the east, unconformably underlying the Murrysville, are gray Devonian-age shales generally assigned to the Conewango Group or to "Devonian undifferentiated." These shales contain interbedded siltstones and sandstones. They are over 350 feet thick in Well No. 12, Fayette County, but are only 140 feet thick a considerable distance eastward in Well No. 13, Somerset County; and they are abruptly thinner westward (105 feet) in Well No. 11, Fayette County. Absent in Washington County, Pennsylvania, (where the Berea-Murrysville is very thick) these Conewango shales reappear in Brooke, Carroll, and Jefferson Counties, and disappear further west.

CATSKILL FORMATION AND THE "RED BEDFORD"

The Catskill Formation, under the Conewango, is composed chiefly of red shales with substantial amounts of red and gray interbedded sandstones and conglomerates, and gray shales. They thicken and coarsen to the east.

The "Red Bedford" is 70 feet thick in Well No. 3 (Wayne County) and occurs in the subsurface at least as far west as Huron County, Ohio. Farther west, it is absent, having been removed by pre-Berea and post-Berea erosion. As the Berea resembles the Murrysville but is typically finer-grained, so the "Red Bedford" is similar in lithology to the Catskill, but is finer-grained, as if they were the same unit, the "Red Bedford" being further from the source area. We believe they are the same formation.

The "Red Bedford" thins eastward; and the Catskill thins

westward; and in Stark County, Ohio — between them in the Figure — both are absent. The gray shales found in this place are generally considered to be the older Chagrin shale. These points suggest an anticline in the Devonian, the axis of which trends north-south through the place where the "Red Bedford" and Catskill are both absent. The lack of identifiable bedding markers (such as might be found in geophysical logs) prevent testing this suggestion.

UNCONFORMITY AT THE BASE OF THE BEREA AND MURRYSVILLE SANDSTONES

The Berea and Murrysville Sandstones are considered to be the same unit. That they have been deposited on an unconformity surface is indicated by 1) the variety of formations underlying them, 2) the lag gravels and other lithologies indicative of unconformity found in the lowermost samples of each, and 3) the irregular thicknesses of each. The variation of interval from the base of the Sunbury Shale (assumed to be relatively smooth surface) and the base of the sandstones, is thought to be complementary to the irregularity of the initial surface of deposition.

The greater thicknesses of the Murrysville Sandstone in Washington County, Pennsylvania (Wells nos. 9 and 10) suggest a channel in the lower surface at this longitude. Another "channel" of thickened Berea Sandstone in Stark County, Ohio, (Wells nos. 4 and 5) may overlie an anticlinal flexure, since the Berea thickness seems scarcely enough to have breached the thickness of "Red Bedford" or Catskill expectable here.

The time required to flex the rock and carve out the

erosion surface appears substantial; and the unconformity is thus deduced to be significant. It is considered to be the Devonian-Mississippian boundary at its east end; and elsewhere along it, Mississippian rocks are above and Devonian rocks are below (if "Red Bedford" equals Catskill, as here asserted) so the unconformity is the Devonian-Mississippian boundary all along the section.

CLEVELAND SHALE

The Cleveland Shale, a black, carbonaceous, marine shale, is 160 feet thick in Well No. 1, Medina County. It extends no further eastward, apparently having been replaced by Chagrin Shale.

CHAGRIN SHALE

The Chagrin Shale in the subsurface is typically a medium-gray to greenish-gray shale with interbedded siltstones, sandy siltstones, sandstones, and some black shales. It thickens and coarsens to the east. It is 240 feet thick in Well No. 1 (Medina County) and thickens abruptly eastward at the expense of overlying Cleveland and underlying Huron Shales.

To the east Chagrin lithology grades into Brallier lithology, gray shales with interbedded siltstones and sandstones as described under the name Brallier on the Southern Tie Section (Figure 4, following).

In Stark County, Ohio, the red shale overlying Chagrin in Wayne and Carroll Counties on either side is absent, probably lost to channeling and flexing under the Berea if, as asserted, the "Red Bedford" is simply an extension of Catskill and, therefore, Devonian in age.

HURON SHALE

The Huron Shale is black, carbonaceous, radioactive, marine shale with some interbedded gray shales. Its upper part is replaced eastward by Chagrin lithology.

OLENTANGY SHALE

The Olentangy Shale in the subsurface is typically a greenish-gray to medium-gray limy shale with some interbedded calcareous siltstones and noncalcareous radioactive black shale.

These lower units of the Devonian shales have been described to point out the angle between Devonian and Mississippian bedding planes which may represent tectonism during the erosion period between Devonian and Mississippian time.

NORTH-SOUTH OHIO-KENTUCKY CROSS SECTION

This cross section (Figure 3) extends from Cuyahoga County in northern Ohio to Boyd County, Kentucky. It deviates east and then west to compare stratigraphies with the area where "Red Bedford" is absent.

BEREA SANDSTONE

The Berea Sandstone in the subsurface is relatively fine grained and silty along this north-south cross section (Figure 3). It is 61 feet thick in the Cuyahoga County well, thins southward to 12 feet in Well No. 3 (Medina County), and then thickens to 28 feet in Well No. 5 (Holmes County). Maintaining its thickness in Holmes and Muskingum County, the Berea Sandstone thickens to 65 feet in Well No. 8 (Perry County). Farther south it is more or less uniform in thickness. The

variation in thickness of Berea along this cross section suggests an irregular surface of initial deposition.

In the north in Well No. 1 (Cuyahoga County), where Berea Sandstone overlies Chagrin Shale, the "Red Bedford" is absent, we suspect because of (pre-Berea) erosion. In Medina, Wayne, and Holmes County wells, the "Red Bedford" is present over the Chagrin. Absent in Well No. 6 (Holmes County) where the section was offset east, the "Red Bedford" overlies the Cleveland Shale farther south. In Wells no. 11 and 12 (Boyd County, Kentucky) near the Rome Trough, the "Red Bedford" is replaced by medium-gray, silty and sandy shale generally assigned to the Bedford Shale. In Well No. 11 (Boyd County), there is no red shale, but the medium-gray shale contains stringers of brown shale.

The disappearance of red shale and appearance of gray shale at the same position across the Mavity Monocline in the Rome Trough suggest that the gray color may be secondary, altered from red in a reducing environment in deeper water with poor circulation.

(Samples were missing in Well No. 2 (Medina County).

The "Red Bedford" is more or less uniform in thickness north to south and thins toward the east. (Wells No. 5, 6, and 7 are in the east where "Red Bedford" thins and then disappears near the hinge line of the anticline suggested for the east-west cross section.) The relative uniformity of thickness north and south of the Red Bedford suggests that the source of sediment was east rather than north: uniform thicknesses usually imply uniform distances from the source.

CLEVELAND SHALE

Black Cleveland Shale is overlain by gray Bedford Shale in Boyd County, Kentucky, south of the Mavity monocline, but northward to Muskingum County (Well No. 7) the Cleveland Shale is overlain by "Red Bedford." In the offset part of the section (Well No. 6) and farther north, the Cleveland is apparently in facies relationship with Chagrin (as discussed under the east-west cross section).

CHAGRIN SHALE

The Chagrin Shale underlies Berea in Well No. 1 (Cuyahoga County) where it is over 300 feet thick. It thickens southward to 580 feet in Well No. 5 (Holmes County), then thickens abruptly where the section is offset east. Then it thins southward (under the Cleveland) to 97 feet in Well No. 11 (Boyd County, Kentucky). In Well No. 12 (Boyd County), across the Mavity monocline, it is 140 feet thick.

The Huron Shale is under the Chagrin, and the Olentangy under the Huron.

THE SOUTHERN TIE SECTION

The Southern Tie Section (Figure 4) extends from the craton in Ohio to the Valley and Ridge province in Virginia, in the eastern part of the Appalachian Basin. It crosses three faults and the projection of the Pine Mountain fault, which last seems to have no direct effect on the stratigraphy as one might expect if the Pine Mountain decollement involved major lateral displacement.

The section is "hung" on the base of the Sunbury Shale, present across the whole section. The Sunbury is lithologically like the Devonian Cleveland Shale, so where the Berea Sandstone is absent, the Devonian-Mississippian boundary is difficult to identify. However, westward at Farmers in Rowan County, Kentucky, the Berea is absent but Bone Bed 19 (Conkin and Conkin, 1979) occurs just below the Sunbury Shale. This is the earliest Mississippian bone bed they recognize.

THE BEREA-BEDFORD FORMATIONS

In the absence of samples or a trustworthy driller's log, differentiation between Berea Sandstone and Bedford Shale is very difficult, for their appearances on geophysical logs are similar. Where they can be differentiated, we presume that the Berea is Mississippian and the Bedford Shale is Devonian. We feel the Bedford Shale in Kentucky is not the same as the Bedford in Cuyahoga County, Ohio, as described by deWitt (1970). His Figure 2 shows the Bedford mostly Mississippian in age.

BEREA SANDSTONE

The Berea Sandstone has irregular thickness across the section. The abrupt thinning southeastward of the Berea to the thin Cloyd Conglomerate between Carter Coordinate Sections 2-I-88 and 4-H-89 resembles the southwestward (normal to the line of section) pinching out of the Berea: we have no structural explanation (since no Valley and Ridge faults are known between these two wells) for this resemblance. The Cloyd is very coarse and conglomeratic at its outcrop and resembles the Murrysville of Pennsylvania.

We identify an unconformity under the Berea and Cloyd, and believe it is, as in the other sections, the Devonian-Mississippian boundary. The "Red Bedford" does not appear on the section. Possibly it is absent in 25-Z-81, Scioto County, Ohio, and westward by pre-Berea erosion.

The Cleveland Shale extends across most of the section, but is replaced by Brallier lithology (gray shales with interbedded siltstones and sandstones) in 3-K-87, Pike County, Kentucky, and southeast. The name Brallier is adopted from Bartlett and Webb, (1971).

The lower units of the Devonian shales diverge southeastward, but the angularity between their bedding and Mississippian bedding is not as marked as in the east-west Ohio-Pennsylvania section described earlier.

DISTRIBUTIONS OF CATSKILL AND "RED BEDFORD"

Figure 5, the index map, shows the distributions of Catskill and "Red Bedford" shales separated by a channel where both are missing. The eastward thinning of "Red Bedford" and westward thinning of Catskill suggest upfolding along a hinge line or the axis of an anticline passing north-south down the channel. We postulate that weak surface rocks near the hinge line has facilitated the channel erosion.

In the narrow brown shale zones east of "Red Bedford" and west of Catskill , the shale below the Berea (Chagrin) contains stringers of dark-brown shale. Brownish-gray shales below the Berea occur in the channel between the two narrow brown zones. This brown coloration in the shales is probably due

to oxidation and hydration occurring when the unconformity was being developed.

Red Bedford of the craton is replaced by gray Bedford at and south of the Mavity monocline in the Rome Trough. We theorize that here the sediment was red when deposited but lost its color by chemical reduction in the deep reducing environment of the Trough.

CONCLUSIONS

1) The Berea Sandstone is a correlate of the Murrysville Sandstone and the Cloyd Conglomerate, and these in fact are the same unit.
2) The unconformity at the base of the Berea, Murrysville, and Cloyd is the Devonian-Mississippian boundary, and these sandstones are the initial deposits of the Mississippian System.
3) The "Red Bedford" is an extension of the Catskill and is Devonian in age.
4) The loss of red coloration of the Bedford south of the Mavity monocline is post-depositional.
5) The transition from Devonian to Mississippian time (in this area) is marked by the physical event of emergence and the development of an unconformity surface.

ACKNOWLEDGMENTS

The sample studies used herein were chiefly done by J. S. Zafar while employed by Geological Sample Log Company (Geolog), Pittsburgh, Pennsylvania. We also thank the Geological Sample Log Company for permission to use their sample studies by other geologists. All the sample studies are commercially available through them.

REFERENCES CITED

Bartlett, Charles S., Jr., and Webb, Harry W., 1971, Geology of the Bristol and Wallace quadrangles, Virginia: Virginia Division of Mineral Resources Report of Investigations 25, 93 p.

Conkin, J. E., and Conkin, B. M., 1979, Guide to Devonian-Mississippian Boundary in southern Indiana and Northwestern Kentucky: Ninth International Congress of Carboniferous Stratigraphy and Geology, Field Trip 7.

deWitt, Wallace, Jr., 1970, Age of the Bedford Shale, Berea Sandstone, and Sunbury Shale in the Appalachian and Michigan Basins, Pennsylvania, Ohio, and Michigan: U.S. Geological Survey Bull. 1294-G, pp G1-G11, 4 Figs.

Hoover, Karl V., 1960, Devonian-Mississippian shale sequence in Ohio: Ohio Division of Geological Survey Information Circular No. 27, 154 p.

FIGURE CAPTIONS

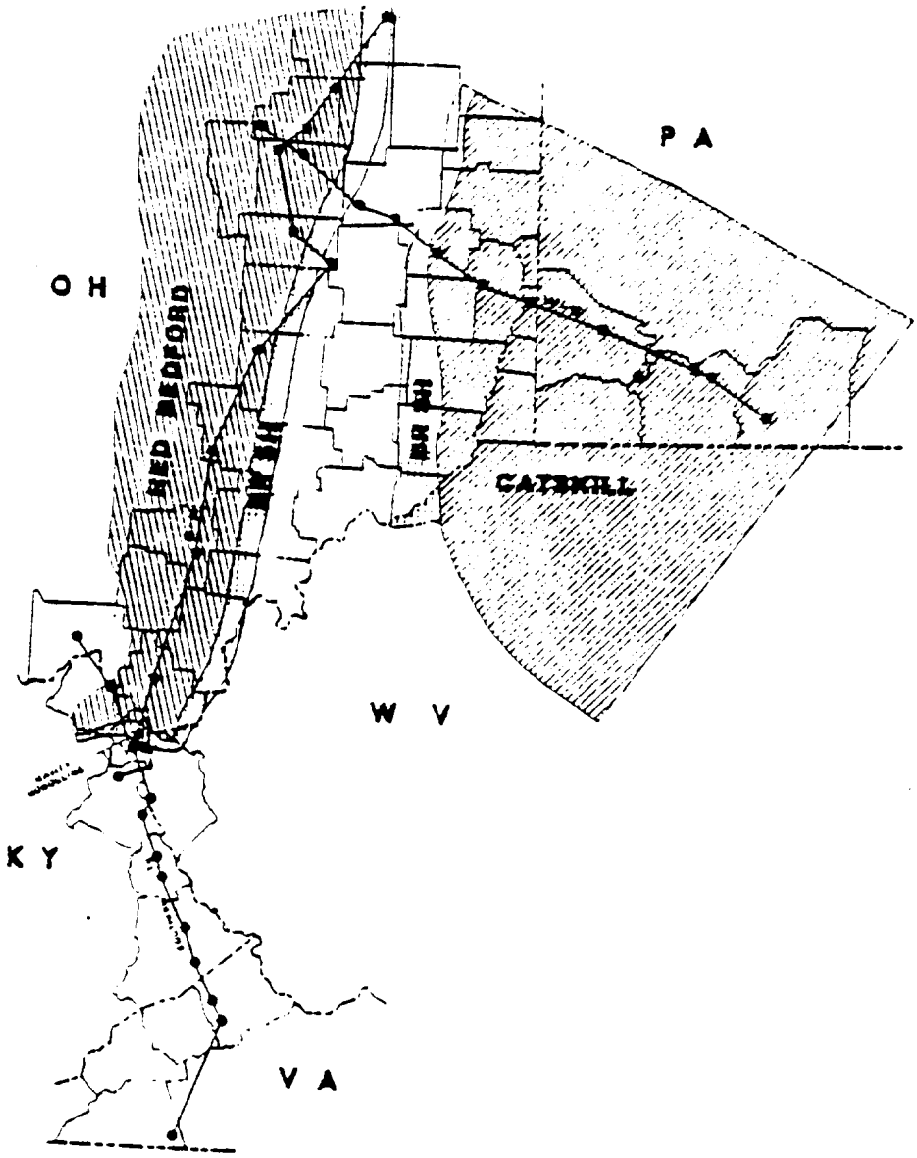
Figure 1 — Index map showing subsurface distributions of the "Red Bedford" and Catskill Formations, the location of the Mavity monocline (northwestern-most fault of the Rome Trough), and lines of section for three stratigraphic sections.

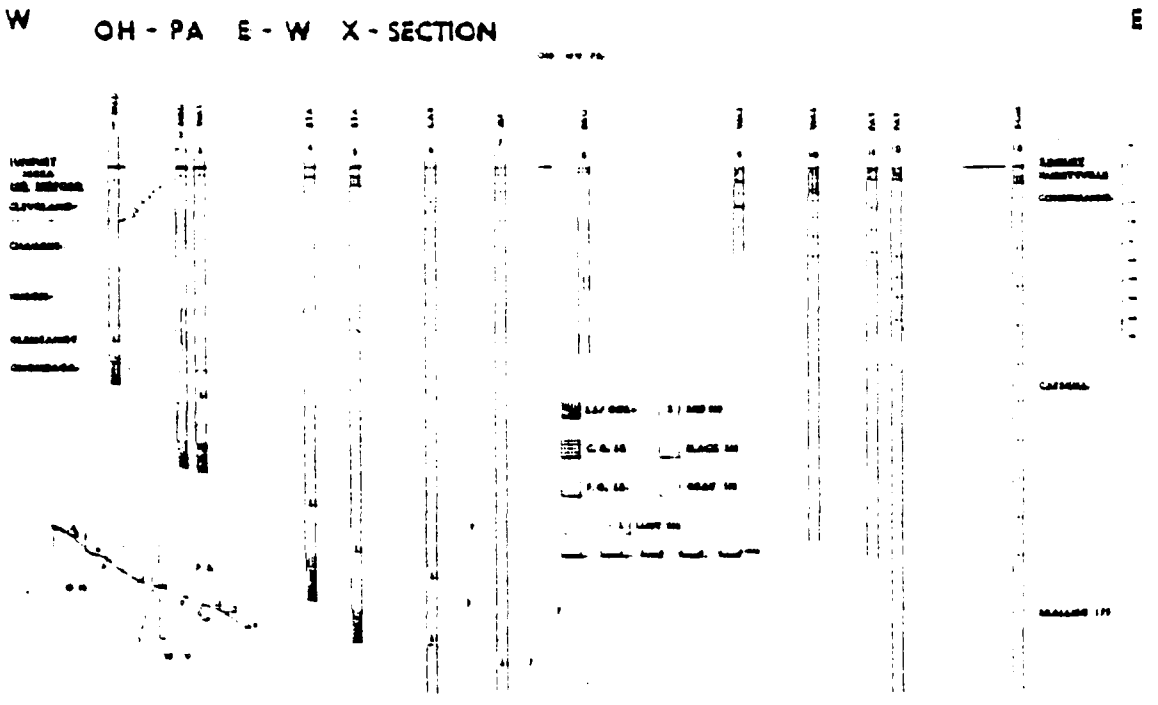
Figure 2 — A west-to-east subsurface stratigraphic cross section from Medina County, Ohio, to Somerset County, Pennsylvania, illustrating the relationships between the Berea and Murrysville Sandstones and the "Red Bedford" and the Catskill Formations. The Devonian-Mississippian boundary is identified as an unconformity at the base of the Berea and Murrysville. Wells used in the section are identified in the table below.

Figure 3 — A north-to-south subsurface stratigraphic cross section from Cuyahoga County, Ohio, to Boyd County, Kentucky, illustrating the continuity of the "Red Bedford" and its termination near the Mavity monocline. The Devonian-Mississippian boundary is identified as an unconformity between the Bedford Shale and the Berea Sandstone and its equivalents. Wells used in the section are identified in the table below.

Figure 4 — The Southern Tie Section, a subsurface stratigraphic cross section transverse to the Appalachian Basin from Ross County, Ohio, to Scott County, Virginia, that is, from the flank of the Cincinnati Arch across the Rome Trough to the Valley and Ridge Province. The Devonian-Mississippian boundary appears to be an angular unconformity at the base of the Berea Sandstone and its equivalent, the Cloyd Conglomerate.

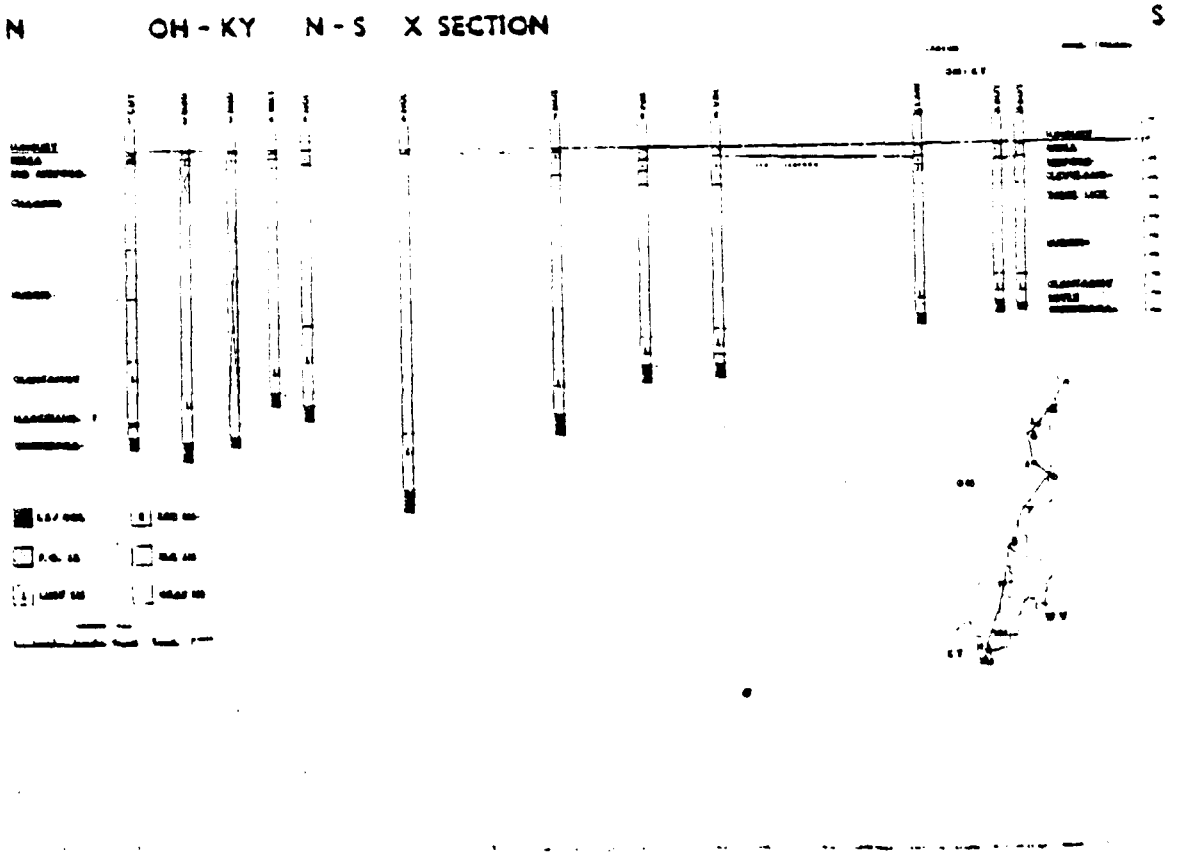
Figure 5 — Index map showing subsurface distributions of the Red Bedford and Catskill Formations, the location of the Mavity monocline (northwesternmost fault of the Rome Trough), and lines of section for three stratigraphic sections.


P A
O H
RED BEDFORD
CATSKILL
W V
K Y
V A



WELL DATA IN OHIO-PENNSYLVANIA WEST-EAST CROSS-SECTION

No.	State	County	Operator	Well # — Lease Name		TWP or Dist.	Datum Elev.	Total Depth	Result & Comp. Date	
1.	OH	Medina	Moore	#1	WANDEL	Homer	1092KB	5667	D&A	01/20/1973
2.	OH	Medina	King	#1	NEWMAN	Guilford	1080GL	3470	D&A	12/04/1974
3.	OH	Wayne	Atlas	#1	HARTZLER	Wayne	1161GL	5977	GAS	07/29/1962
4.	OH	Stark	East Ohio	#1	JOHNSTON	Bethlehem	1057GL	4469	GAS	10/24/1956
5.	OH	Stark	Belden	#1	OVERLY	Pike	--	5040	OIL	03/30/1953
6.	OH	Carroll	Pan American	#1	SCHOTT	Union	1146GL	6024	OIL	03/26/1968
7.	OH	Jefferson	Lake Shore	#1	MISER	Salem	1148GL	4878	D&A	12/16/1961
8.	WV	Brooke	McCormick	#1	JENKINS	Cross Creek	1115GL	2505	D&A	07/02/1970
9.	PA	Washington	Young	#1	WALKER	Strabane	1140GL	2792	OIL	10/17/1944
10.	PA	Washington	Louden	#719-1	MARCHANDO	Centerville Boro.	1010GL	4020	GAS	05/26/1978
11.	PA	Fayette	PNG	#2	BELL	Franklin	1335GL	3718	GAS	09/12/1974
12.	PA	Fayette	Acme	#1	BUTTERMORE	Springfield	2215GL	7861	D&A	10/07/1953
13.	PA	Somersac	PNG	#1	HARVEY MARKER	Summit	2522GL	5135	D&A	03/25/1948



WELL DATA FOR THE OHIO-KENTUCKY NORTH-SOUTH CROSS-SECTION

No.	State	County	Operator	Well #1	Lease Name	TWP or Carter Coord.	Datum Elev.	Total Depth	Results	Comp. Date
1.	OH	Cuyahoga	Benedum-Trees	#1	WISE	Highland Hgts	945GL	2818	GAS	02/--/1939
2.	OH	Medina	Wiser	#3-A	H H HIER	Hinckley	1225GL	6031	D&A	10/25/1959
3.	OH	Medina	King	#1	NEWMAN	Guilford	1080GL	3470	D&A	12/04/1974
4.	OH	Wayne	Sun	#1	MARTIN	Chester	1204GL	5750	D&A	10/15/1965
5.	OH	Holmes	Mason	#1	NISLEY	Ripley	1085GL	3404	GAS	08/27/1974
6.	OH	Holmes	Kin-Ark	#1	RABER	Clark	1155GL	6681	D&A	08/06/1968
7.	OH	Muskingum	Pure	#1	MC NAUGHT	Cass	--	3600	GAS	03/15/1957
8.	OH	Perry	Hall	#4	DOWNHOUR	Monday Creek	1020GL	3080	GAS	10/18/1973
9.	OH	Vinton	Baird	#1	OHIO STATE	Vinton	720GL	3225	D&A	02/18/1967
10.	OH	Lawrence	Ballard & Cordell	#1	COLLINS	Decatur	959GL	2519	D&A	01/01/1972
11.	KY	Boyd	Inland Gas	#536	INLAND GAS	2-W-82	748GL	3075	D&A	09/18/1968
12.	KY	Boyd	Inland Gas	#537	FANNIN	22-W-82	708KB	7798	GAS	12/13/1968

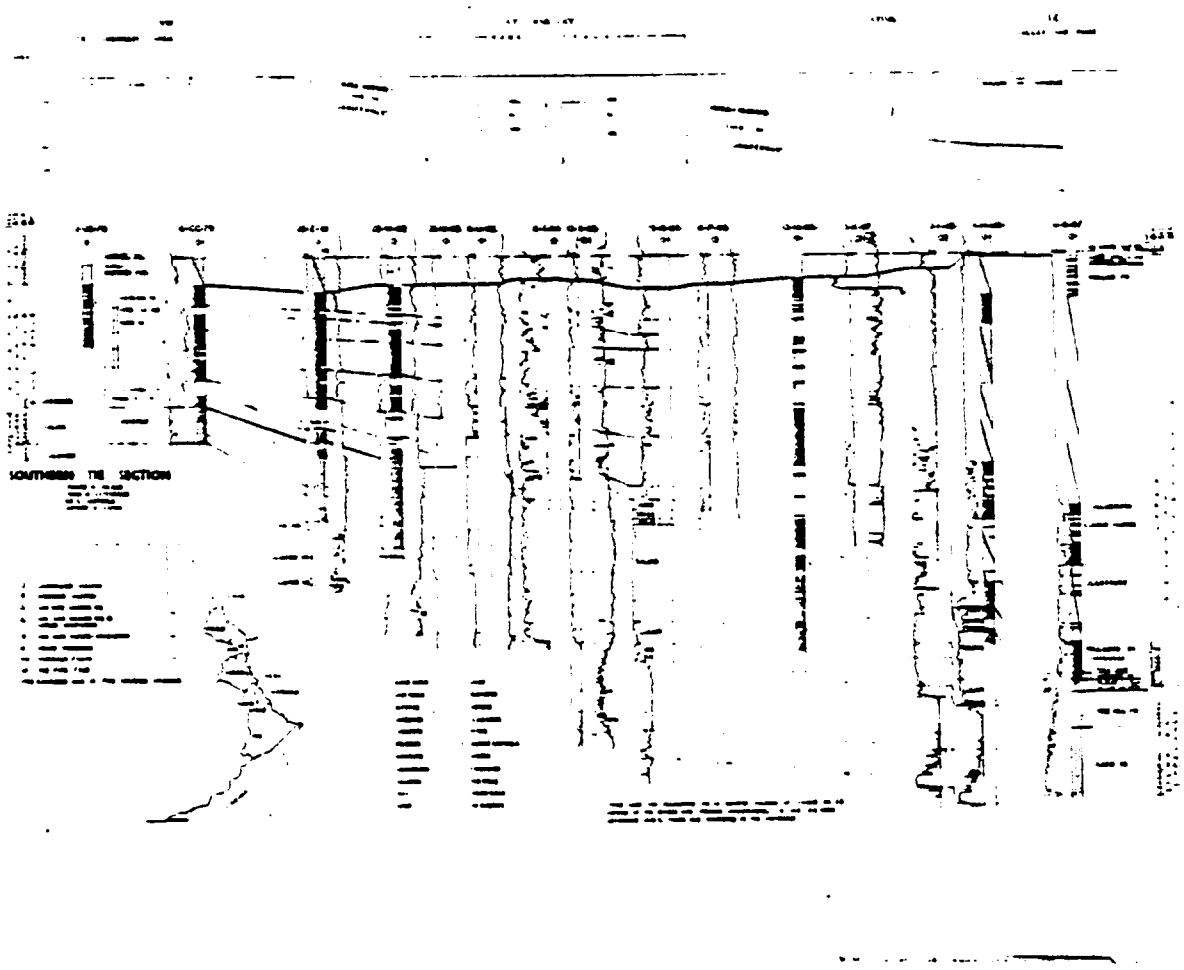
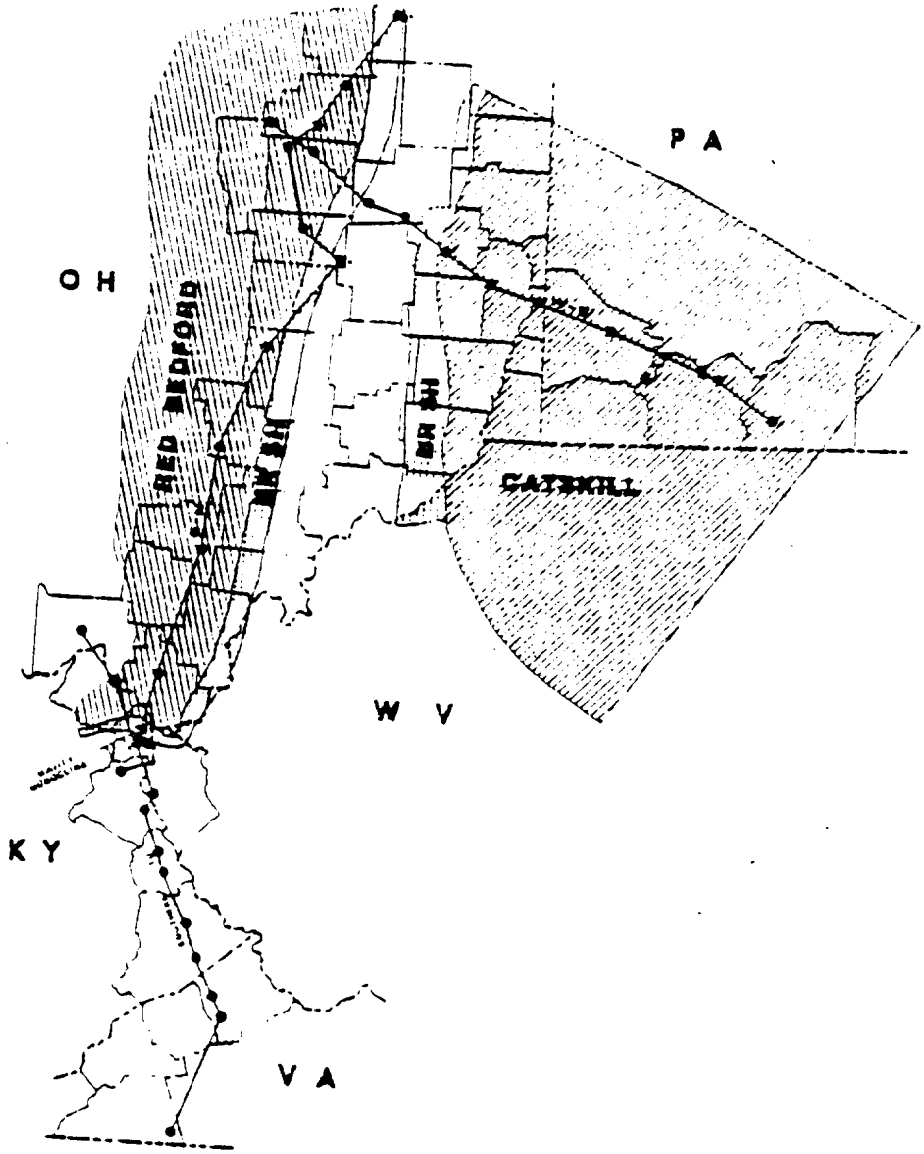


TABLE OF OUTCROP AND WELLS ON SOUTHERN TIE SECTION

	Carter Coord.	State	County	Operator-well#-Farm Name	Elev. Datum	Total Depth	Comp. Date	Status
(a)	2-GG-76	OH	Ross	Outcrop @ COPPERAS MT.		base not exposed		
(b)	16-CC-79	OH	Scioto	Continental #1 SHISLER	531 DF	1075	12-01-1962	D&A
(c)	25-Z-81	OH	Scioto	USS Chemical #1 FEE	557 KB	5607	06-06-1968	HO
(d)	22-W-82	KY	Boyd	Inland Gas #537 FANNIN	708 KB	7800	12-13-1968	Gas
(e)	25-W-83	KY	Boyd	Inland Gas #535 McKEAND	368 KB	9445	06-17-1968	D&A
(f)	6-U-82	KY	Lawrence	Inland Gas #542 YOUNG	884 KB	12534	05-13-1971	D&A
(g)	15-T-84	WV	Wayne	Columbia #20060 FEE	647 KB	3598	03-05-1976	Gas
(h)	10-S-83	KY	Lawrence	Columbia #9557 FIEGER	302 DF	4037	09-23-1971	Gas
(i)	19-Q-84	KY	Martin	United Fuel #1 JAMES	559 KB	13172	05-07-1959	D&A
(j)	16-P-85	KY	Martin	Columbia #20336 FEE	944 KB	3457	11-05-1976	Gas
(k)	10-M-86	KY	Pike	Columbian Fuel #1 SMITH	1068 GL	5343	11-12-1939	D&A
(l)	3-K-87	KY	Pike	Columbia #9697 KENTLAND	1293 DF	4944	12-27-1972	Gas
(m)	2-I-88	VA	Buchanan	Columbia #9781 PITTSTON	1580 KB	6803	09-17-1973	Gas
(n)	4-H-89	VA	Buchanan	Columbia #9722 POBST	1683 KB	7296	04-26-1973	D&A
(o)	6-d-87	VA	Scott	Tidewater #1 SMITH	1468 KB	7222	01-30-1964	Gas


PA
OH
RED BEDFORD
BR SH
BR SH
CATSKILL
WV
KY
VA